were to set $B_f=0.83B_f^{RLDM}$ and $a_f/a_\nu=1.00$, as suggested in Ref. 8, but using our more sophisticated level density treatment, the calculated σ_{fiss} would substantially exceed the measured values at all bombarding energies for all three systems, and the fission-fragment anisotropies measured for ^{6}Li + ^{197}Au would be overpredicted by ~25%.

We conclude that the differing claims in Refs. 6 and 8 concerning high-spin fission barrier heights for A≈200 can be largely attributed to differences in the underlying assumptions and philosophy of the statistical model analyses, although certainly differences in experimental technique and in contributions from competing reaction mechanisms may further cloud the comparison. Our calculations adequately explain the measurements for three widely differing entrance channels to A≈200 CN, reinforcing our earlier conclusion[6] that there is no evidence, at the present level of sophistication of the statistical treatment for an inadequacy of the RLDM-NIFG structure predictions at high spin and excitation in this mass range.

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190 MeV PROTON-INDUCED SYMMETRIC AND ASYMMETRIC FISSION*

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Proton-induced fission (E_p = 190 MeV) has been studied for uranium and several selected nuclei with A between 140 and 210. Fission fragments were detected in the 163 cm diameter scattering chamber using solid-state detectors. Typically a single 300 mm^2 Si detector (<100μm) was placed on one detector arm (θ≈90°) about 15 cm from the target. A three-detector array (600 mm^2 Si; <100 μm) was located about 30 cm away on an opposing detector arm (θ < -90°), with the target set at 45° with respect to the incident beam. Energy signals, and timing signals relative to the cyclotron r.f. and between detectors were used for fragment identification, with energy and relative mass spectra calibrated using a thin ^{252}Cf fission source. The time-of-flight resolution of 0.7 to 1.5 ns (FWHM) was sufficient to separate fission fragments from most of the energetic light ions emitted and provide an approximate mass identification (±10 amu) (see Fig. 1).

The targets consisted of self-supporting rolled metal foils, about 500 μg/cm^2, or in the case of U, Eu,

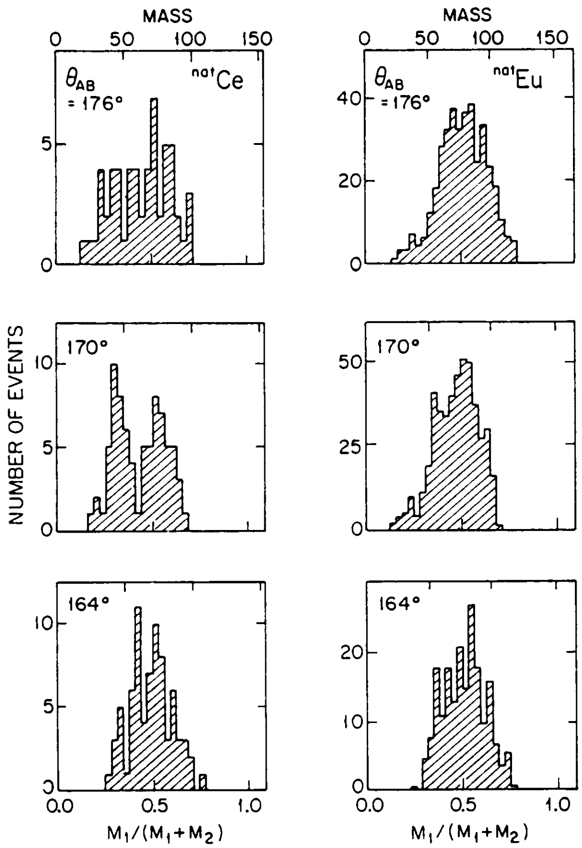

Figure 1. Relative fission mass distributions deduced for the $\theta_{AB} = \theta_A - \theta_B$ (lab) values shown, ($\theta \approx 90°$) assuming $M_1/(M_1+M_2) \approx E_2/(E_1+E_2)$. The angular acceptance of the detectors was 4°.

Lu, Ce, Pr and Ba, chloride or fluoride compounds (<400 μg/cm^2) evaporated onto thin carbon foils. The PrF_3, LuF_3 and CeF_3 material was obtained[1] in ultra pure form with <10^{-7} parts heavy element contamination. Most of the targets were also checked with X-ray fluorescence (≈10^{-5} parts sensitivity).

Fragment kinetic energy spectra (E_1, E_2, ...) and partial angular correlations (>3 angles) were obtained for most of the targets near $\theta = 90°$. Angular distributions were obtained for ^{159}Tb, ^{197}Au and U, and are nearly isotropic.

Relative fission mass spectra [assuming $M_1/(M_1+M_2) \approx E_2/(E_1+E_2)$] are displayed in Fig. 1 for Ce and Eu. These have been obtained by gating on the fragments' time-of-flight and summed kinetic energy. The latter, to within a few MeV, follows the $Z^2/A^{1/3}$ dependence expected for binary fission.[2] The data for ^{140}Ce indicates highly asymmetric fission (Figs. 1 and 2) at E_p=190 MeV even in the presence of high fission barriers. Our results appear to confirm those recently obtained at E_p = 600 MeV for A = 140 (Fig. 3). Similarly our data for Pr, Eu and Tb (i.e. A < 160) exhibit a very broad relative mass division (e.g. Fig. 1) possibly suggesting a Businaro-Gallone effect.[3] The cross section data have been compared with statistical-model fission calculations modified[5] to include pre-compound nucleon emission (Fig. 4). The data can be reproduced using standard fission-barrier and level-density parameters, viz. $B_F = B_F^{LDM}$ and $a_F = 1.05\ a_N$.

A short paper describing the results of the first phase of this work has been submitted for publication (Phys. Rev. C). A more complete analysis of all the data is in progress.

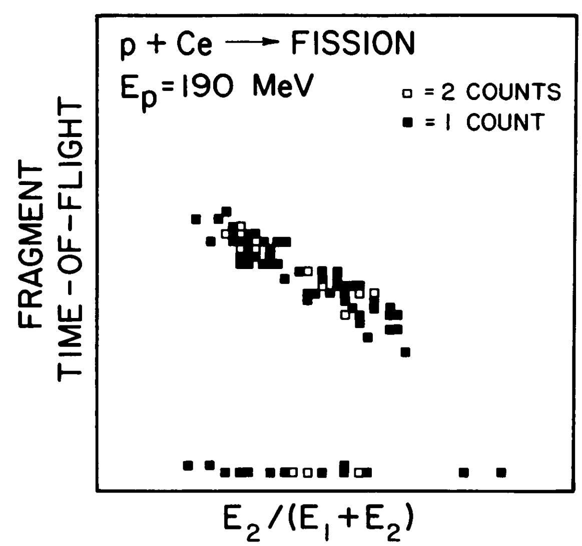

Figure 2. A two-dimensional spectrum displaying p+Ce fission fragment time-of-flight (relative to cyclotron r.f.) vs. $E_2/(E_1+E_2)$ [$\approx M_1/(M_1+M_2)$]. The data are consistent with $M_1 \approx 50$ and $M_2 \approx 80$.

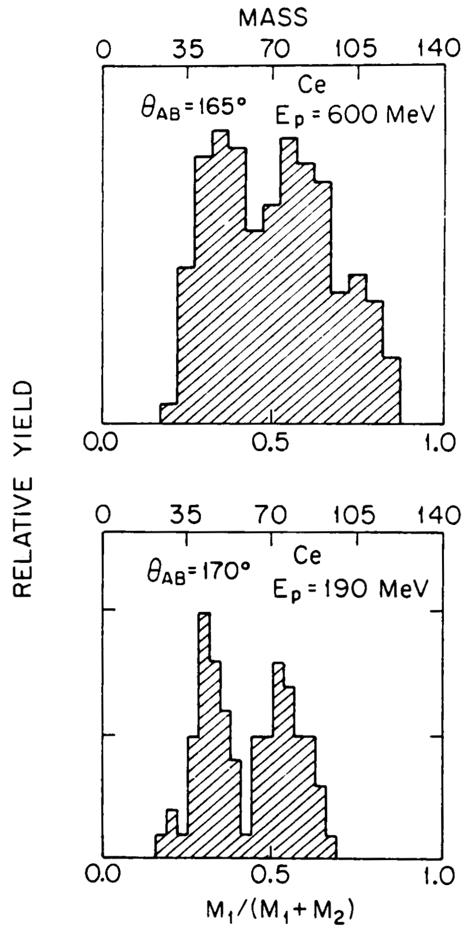

Figure 3. A comparison of fission mass distributions observed for E_p = 600 MeV (top; Ref. 3) and E_p = 190 MeV (this experiment).

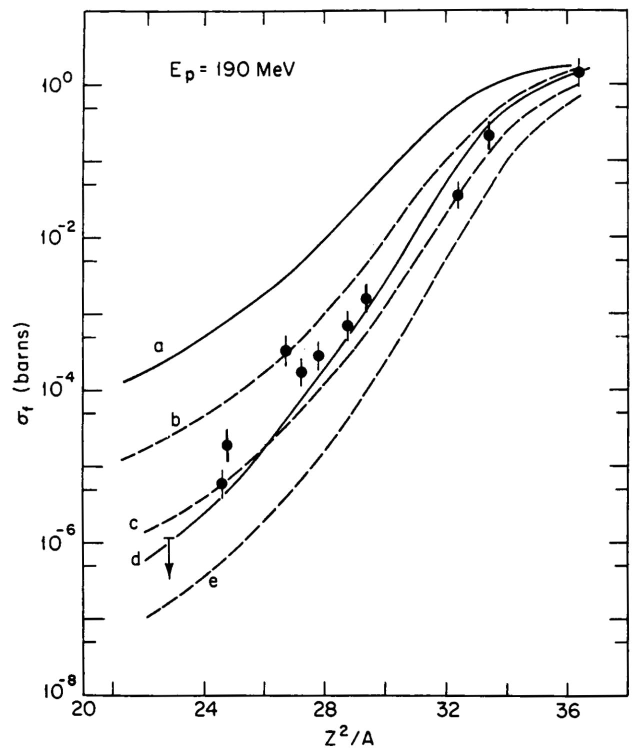

Figure 4. Results of statistical-model fission calculations which include precompound nucleon emission with a geometry-dependent hybrid model (Ref. 5). The curves correspond to the following parameters: Solid curves: a_f/a_n = 1.05 with B_f = 0.7 B_f^{LDM} (curve a), and B_f = B_f^{LDM} (curve d); broken curves: a_f/a = 1.00 with B_f = 0.7 B_f^{LDM} (curve b), = 0.85 B_f^{LDM} (curve c) and = 1.0 B_f^{LDM} (curve e).

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